

Application No. 10/007,288
Amendment dated August 6, 2003
Reply to office action of May 8, 2003

Amendments to the Claims

This listing of claims will replace all prior versions, and listing, of claims in the application.

Listing of Claims

25. (Previously Presented) A method for making a wafer-pair having deposited layer plugged sealed chambers, comprising:
- growing a thermal layer on a first side of a first wafer;
 - depositing a nitride layer on the thermal layer;
 - depositing, patterning and removing portions of first metal layer on the nitride layer for a plurality of devices;
 - depositing, patterning and removing portions of a second metal layer on the nitride and first metal layers for the plurality of devices;
 - patterning and removing material from the first wafer and layers on the first side of the first wafer and from a second side of the first wafer to make a plurality of pump-out ports through the first wafer and layers on the first wafer;
 - masking and removing material from a first side of a second wafer to form a plurality of recesses in the first side of the second wafer;
 - forming a sealing ring on the first side of the second wafer around each of the plurality of recesses; and
 - positioning the first side of the first wafer next to the first side of the second wafer; and
- wherein:

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each sealing ring is in contact with at least one of the layers on the first side of the first wafer;

each recess of the plurality of recesses results in a chamber containing at least one device of the plurality of devices;

each sealing ring encloses at least one pump-out port of the plurality of pump-out ports;
and

the first and second wafers are effectively a bonded together set of wafers.

26. (Previously Presented) The method of claim 25, further comprising:

placing the set of wafers in an environment of a vacuum wherein a vacuum occurs in each chamber via the at least one pump-out port; and

depositing a layer of material on the second side of the first wafer and the plurality of pump-out ports on the second side of the first wafer, wherein each chamber is sealed from the environment.

27. (Previously Presented) The method of claim 26, further comprising baking out the set of wafers prior to depositing the layer of material on the second side of the first wafer and the plurality of pump-out ports on the second side of the first wafer.

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28. (Previously Presented) The method of claim 27, further comprising coating the second wafer with antireflection material.
29. (Previously Presented) The method of claim 28, wherein the second wafer is made from a material that is at least substantially transparent to light in the infrared spectrum.
30. (Previously Presented) The method of claim 29, wherein the plurality of devices comprise thermoelectric detectors.
31. (Previously Presented) The method of claim 30, wherein the plurality of devices comprise bolometers.
32. (Previously Presented) A method for making a wafer-pair having at least one deposited layer plugged sealed chamber, comprising:
- growing a first thermal layer on a first side of a first wafer;
 - depositing a nitride layer on the first thermal layer,
 - depositing and patterning a first metal layer on the nitride layer for at least one device;
 - depositing and patterning a second metal layer on the nitride layer and the first metal layer for the at least one device;

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patterning and removing material from the first wafer and layers on the first side of the first wafer and from a second side of the first wafer to make a pump-out port through the first wafer and the layers on the first wafer;

masking and removing material from a first side of a second wafer, to form a recess in the first side of the second wafer;

forming a sealing ring on the first side of the second wafer around the recess;

positioning the first side of the first wafer next to the first side of the second wafer; and

wherein:

the sealing ring is in contact with at least one of the layers on the first side of the first wafer;

the at least one device is within the recess resulting in a chamber containing the at least one device;

the pump-out port is within the sealing ring; and

the first and second wafers are effectively a bonded together set of wafers.

33. (Previously Presented) The method of claim 32, further comprising:

placing the bonded together set of wafers in an environment of a vacuum wherein a vacuum occurs in the chamber via the pump-out port; and

depositing a layer of material on the second side of the first wafer and the pump-out port on the second side of the first wafer, wherein the chamber is sealed from the environment.

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34. (Previously Presented) The method of claim 33, further comprising baking out the bonded together set of wafers prior to depositing the layer of material on the second side of the first wafer and the pump-out port on the second side of the first wafer.

35. (Previously Presented) The method of claim 34, wherein the at least one device is a detector.

36. (Previously Presented) The method of claim 35, wherein the at least one device is a thermoelectric detector.

37. (Previously Presented) The method of claim 34, wherein the at least one device is an emitter.

38. (Previously Presented) A method for making a wafer-pair having sealed chambers, comprising:

patterning and removing material from a first wafer to make a plurality of pump-out ports through the first wafer;

masking and removing material from a first side of a second wafer to form a plurality of recesses in the first side of the second wafer;

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forming a sealing ring on a first side of the first wafer or the first side of the second wafer such that the sealing ring extends around each of the plurality of recesses; and
positioning the first side of the first wafer next to the first side of the second wafer, and
wherein:
each sealing ring is in contact with the first side of the first wafer and the first side of the second wafer
each recess of the plurality of recesses results in a chamber;
each sealing ring encloses at least one pump-out port of the plurality of pump-out ports;
and
the first and second wafers are effectively a bonded together set of wafers.

39. (Previously Presented) The method of claim 38, further comprising:
placing the set of wafers in an environment of a vacuum wherein a vacuum occurs in each chamber via a pump-out port; and
depositing a layer of material on a second side of the first wafer to seal the plurality of pump-out out ports from the second side of the first wafer, wherein each chamber is sealed from the environment.

40. (Previously Presented) The method of claim 39, further comprising baking out the set of wafers prior to depositing the layer of material on the second side of the first wafer.

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41. (Previously Presented) The method of claim 40, wherein the set of wafers is cut into a plurality of chips wherein each chip has one or more sealed chambers.

42. (Previously Presented) The method of claim 40, wherein the one or more sealed chambers contains one or more devices.

43. (Previously Presented) The method of claim 38, further comprising:
placing the set of wafers in an environment of a gas wherein the gas enters each chamber via a pump-out port; and

depositing a layer of material on a second side of the first wafer to seal the plurality of pump-out ports from the second side of the first wafer, wherein each chamber is sealed from an ambient environment.

44. (Currently Amended) A method for making a wafer-pair with a sealed chamber therebetween, comprising:

providing a first wafer and a second wafer;

forming one or more pump-out ports through the first wafer;

positioning a first side of the first wafer next to a first side of the second wafer with a sealing ring therebetween, the first wafer and the second wafer and the sealing ring forming at

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least part of a chamber, with the pump-out port of the first wafer in fluid communication with the chamber; and

exposing the chamber to a negative pressure relative to atmosphere while plugging the
pump out port to seal the chamber.

45. (Currently Amended) A method according to claim 44 further comprising the step of:

making a recess in the first side of the first wafer and/or the first side of the second wafer, wherein the recess is ~~in registration with~~ forms part of the chamber.

46. (Previously Presented) A method according to claim 44 further comprising the step of:

providing one or more devices in or on the first side of the first wafer and/or the first side of the second wafer before the positioning step.

47. (Currently Amended) A method according to claim 46 wherein the one or more devices are ~~in registration with~~ the chamber.

48. (Currently Amended) A method for making a wafer-pair with a sealed chamber therebetween, comprising:

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providing a first wafer and a second wafer;
forming one or more pump-out ports through the first wafer;
making a recess in a first side of the first wafer and/or a first side of the second wafer;
positioning the first side of the first wafer next to the first side of the second wafer, the first wafer and the second wafer forming a chamber that is at least partially defined by the recess, with the pump-out port of the first wafer in fluid communication with the chamber; and
exposing the chamber to a negative pressure relative to atmosphere while plugging the pump out port to seal the chamber.

49. (Currently Amended) A method for making a wafer-pair with a sealed chamber therebetween, comprising:

providing a first wafer having a first side, with one or more bond pads on the first side;
providing a second wafer;
forming one or more bond-pad holes through the second wafer;
positioning the first side of the first wafer next to a first side of the second wafer ~~with a sealing ring therebetween~~; the first wafer and, the second wafer ~~and the sealing ring~~ forming at least part of a chamber, the first wafer and second wafer being aligned so that the bond-pad holes in the second wafer are in registration with provide physical access to the one or more bond pads on the first wafer through at least selected bond-pad holes in the second wafer; and
the first and second wafers are effectively a bonded together set of wafers.

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50. (Currently Amended) A bonded wafer pair, comprising:

a first wafer;

a second wafer;

the first wafer having one or more pump-out ports through the first wafer;

the first side of the first wafer bonded to a first side of the second wafer via a sealing ring; the first wafer, the second wafer and the sealing ring forming a chamber, with the pump-out port of the first wafer in fluid communication with the chamber, the chamber having a negative pressure therein relative to atmosphere; and

a plug for plugging the pump out port.

51. (Currently Amended) A bonded wafer pair according to claim 50 further comprising a recess in the first side of the first wafer and/or the first side of the second wafer, wherein the recess ~~is in registration with~~ forms at least part of the chamber.

52. (Previously Presented) A bonded wafer pair according to claim 50 further comprising one or more devices in or on the first side of the first wafer and/or the first side of the second wafer.

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53. (Currently Amended) A bonded wafer pair according to claim 52 wherein the one or more devices are in ~~registration with~~ the chamber.

54. (Currently Amended) A bonded wafer pair having a sealed chamber, comprising:
a first wafer;
a second wafer bonded to the first wafer;
one or more pump-out ports through the first wafer;
a recess in a first side of the first wafer and/or a first side of the second wafer;
the first wafer and the second wafer forming a chamber that includes the recess, with the pump-out port of the first wafer in fluid communication with the chamber, the chamber having a negative pressure therein relative to atmosphere; and
one or more plugs for plugging the one or more pump out ports to seal the chamber.

55. (Currently Amended) A bonded wafer pair, comprising:
a first wafer having a first side, with one or more bond pads on the first side;
a second wafer, with one or more bond-pad holes through the second wafer;
the first side of the first wafer bonded to a first side of the second wafer with a sealing ring therebetween, the first wafer and second wafer being aligned so that the bond-pad holes in the second wafer ~~are in registration with~~ provide physical access to the one or more bond pads on the first wafer through at least selected bond-pad holes in the second wafer; and

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the first wafer, the second wafer and the sealing ring forming a chamber.

56. (New) A method according to claim 44 wherein a sealing ring is positioned between the first side of the first wafer and the first side of the second wafer, and wherein the first wafer, the second wafer and the sealing ring form the chamber.

57. (New) A method according to claim 46 wherein the one or more devices include an array of infrared detectors.

58. (New) A bonded wafer pair according to claim 52 wherein the one or more devices include an array of infrared detectors.

59. (New) A method for making a wafer-pair with a sealed chamber therebetween, comprising:

providing a first wafer and a second wafer, the first wafer having a first side and a second side;

forming one or more pump-out ports through the first wafer;

positioning the first side of the first wafer next to a first side of the second wafer, the first wafer and the second wafer forming at least part of a chamber, with the pump-out port of the first wafer in fluid communication with the chamber; and

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providing one or more layer(s) by deposition to a second side of the first wafer, wherein the one or more deposited layer(s) plug the pump out port and seal the chamber.

60. (New) A method according to claim 59 wherein the one or more layer(s) are deposited by evaporation.

61. (New) A method according to claim 59 wherein the one or more layer(s) are deposited by sputtering.

62. (New) A method according to claim 59 wherein the one or more layer(s) include a metal layer.

63. (New) A method according to claim 59 wherein the one or more layer(s) are deposited in a negative pressure relative to atmosphere.

64. (New) A method according to claim 63 wherein the one or more layer(s) are deposited in a high vacuum environment.

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65. (New) An apparatus having a sealed chamber with one or more devices positioned in the sealed chamber, the one or more devices having a desired operating temperature range, the bonded wafer pair comprising:

a first wafer;

a second wafer secured relative to the first wafer;

the first wafer and the second wafer forming a chamber that has a volume, wherein the one or more devices are positioned in the chamber;

one or more pump-out ports through the first wafer, at least one of the one or more pump-out ports in fluid communication with the chamber;

one or more plugs for plugging the one or more pump out ports to seal the chamber; and

the volume of the chamber remaining relatively constant over the desired operating temperature range of the one or more devices.